UNIVERSITI TEKNOLOGI MARA

MARANGONI CONVECTION IN A HORIZONTAL LIQUID LAYER WITH INSOLUBLE SURFACTANT

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Thesis submitted in fulfillment
of the requirements for the degree of
Master of Science

Faculty of Computer and Mathematical Sciences

December 2013

AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any other degree of qualification.

I, hereby, acknowledge that I have been supplied with the Academic Rules and Regulations for Post Graduate, Universiti Teknologi MARA, regulating the conduct of my study and research.

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ABSTRACT

Thermocapillary (Marangoni) convection either steady or oscillatory is known to cause imperfection in the quality of products. The dynamics of the convective motion in a thin fluid layer and the gradients of the surface tension can be significantly altered by the presence of insoluble surfactant, internal heat generation and the application of a feedback thermal controller. In this study, linearly dependent surface tension gradient on temperature and surfactant concentration with the effects of thermal feedback control and internal heat generation are considered to examine the instability of the steady Marangoni convection. The objectives of this study are to analyze theoretically the effect of heat generation and feedback control on Marangoni convection in a horizontal liquid layer with insoluble surfactant. The layer is bounded from below by a rigid heat-conducting plate and above by a free surface. The linear stability theory of the system is performed to undertake a detail investigation. The critical Marangoni numbers for condition of uniform heat flux revealed lower values in contrast to uniform temperature condition. The system with uniform temperature condition is more stable than the condition of uniform heat flux. Small controller gains are able to stabilize the system but large controller gain becomes a destabilizing factor. Internal heat source destabilizes the system and insoluble surfactant of low concentration has a stabilizing effect. The ability to control by either delaying or advancing the onset of instability can lead to better material processes and achieve optimum outcomes.

ACKNOWLEDGEMENTS

Assalamualaikum warahmatullahiwabarakatuh.

Alhamdulillah, all praises to Allah S.W.T. for giving the strength, blessing and opportunity to complete this thesis. I would like to express my deepest gratitude and special appreciation to my supervisor Associate Professor Dr. Seripah Binti Awang Kechil for her supervision, constant support and guidance during the course of this study. Her invaluable help, comments and suggestions certainly contributed greatly to the success of this research. My heartfelt thanks also goes to my second supervisor Associate Professor Ahmad Sukri Bin Abdul Aziz for his continuous support and suggestions.

A warm appreciation goes to the Institute of Graduate Studies, Universiti Teknologi MARA for giving me the opportunity to pursue the Master in Science Program and providing a good environment for research activities. I am particularly grateful to the Ministry of Higher Education of Malaysia and Universiti Teknologi MARA for granting the Young Lecturer Scheme (TPM) scholarship for this degree. This scholarship had provided me support to further my master studies and opportunity to be involved with many activities related to my research works. I would like to thank all the lecturers in the Mathematics Department of the Faculty of Computer and Mathematical Sciences and friends for being very supportive and very helpful during my studies.

Last but not least, thanks to my beloved parents, Ab Hamid Bin Harun and Norihan Binti Ibrahim, my husband, Eddy Reimi Bin Shamsurija and all family members who always give me the support, advice and endless love. Thank you very much.

TABLE OF CONTENTS

	Page
AUTHOR'S DECLARATION	ii
ABSTRACT	iii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	v
LIST OF TABLES	vii
LIST OF FIGURES	viii
LIST OF NOMENCLATURES	xi
CHAPTER ONE : INTRODUCTION	
1.1 Background of Study	1
1.2 Problem Statement	3
1.3 Objective of the Study	4
1.4 Scope of the Study	4
1.5 Significance of Research	4
1.6 Organization of the Thesis	5
CHAPTER TWO : LITERATURE REVIEW	
2.1 Thermal Instabilities in a Horizontal Liquid Layer	6
2.2 Effect of Feedback Control on Thermal Instabilities in a Horizontal Liquid Layer	9
2.3 Effect of Internal Heat Generation on Thermal Instabilities in a Horizontal Liquid Layer	10
2.4 Thermal Instabilities in a Horizontal Liquid Layer with Insoluble Surfactant Effect	12
2.5 Linear Stability Analysis	13